Thermo Menu

Operator Manual

ThermoScan®

Infrared Temperature Reference

Model: BB 3200

Service Manual

Part Number 501650B

Refer to the BB 3200 Operator's Manual for warranty information.

The information and specifications contained within this service manual are subject to change without notification.

Printed in the U.S.A.

ThermoScan

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Chapter 1
General Information

1.1 Introduction

This technical manual contains information for maintaining the Braun ThermoScan® Infrared Temperature Reference - Model BB 3200.

This manual is not intended to support in-field repair but to provide information and reference only.

Refer to the Operator's Manual for complete information regarding the setup and operation of the BB 3200.

The BB 3200 must not be disassembled as the warranty will be voided and calibration and accuracy may be affected. The only user service function currently available is cavity inspection and cleaning, as specified in the BB3200 Operator's Manual.

Any attempt to service the BB 3200 by anyone other than an authorized Braun ThermoScan service representative may invalidate the warranty.

1.2 Principle of Operation

1.2.1 Thermal Radiation Energy

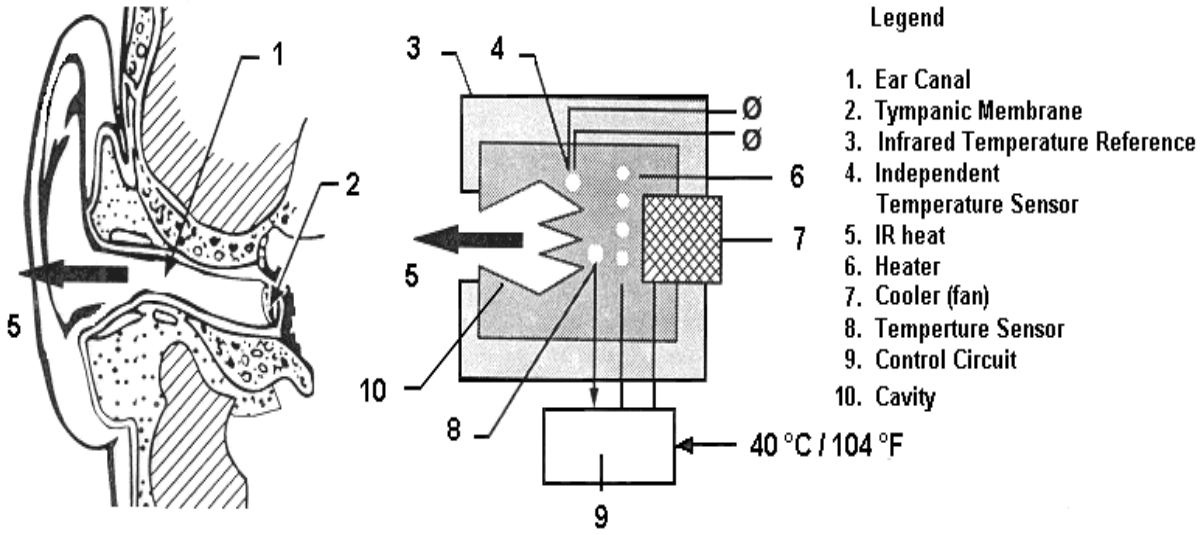
Any material object whose temperature is above absolute zero emits and absorbs electromagnetic energy over a theoretically infinite spectral range. To a physicist, that radiation is just light regardless whether we can see it or not. Glow from the filament of an electric bulb, heat from a bonfire, radio waves which carry sound and TV pictures or X-rays - they all are of the same nature. They are all lights which differ only by the wavelengths. All these waves propagate with the speed of light which is 3.00×10^8 m/s. They can be subjected to similar processing like filtering, reflecting, focusing, etc.

Power of light within a unit bandwidth (the radiant flux density), $W\lambda$, depends on the object's temperature and as a function of wavelength, λ, is given by Planck's equation:

$$W\lambda = \frac{\varepsilon(\lambda) \cdot C1}{\pi\lambda^5 \cdot (e^{C2/\lambda T} - 1)}$$

where $\varepsilon(\lambda)$ is emissivity, $C1 = 3.74 \times 10^{-12}$ W. cm^2 and C2= 1.44 cm.°K are constants, T = T°C + 273.15 (absolute temperature in °K).

Figure 0-1 *Thermal radiation from the ear canal and from the cavity-type blackbody source*



1.2.2 How the BB 3200 Works

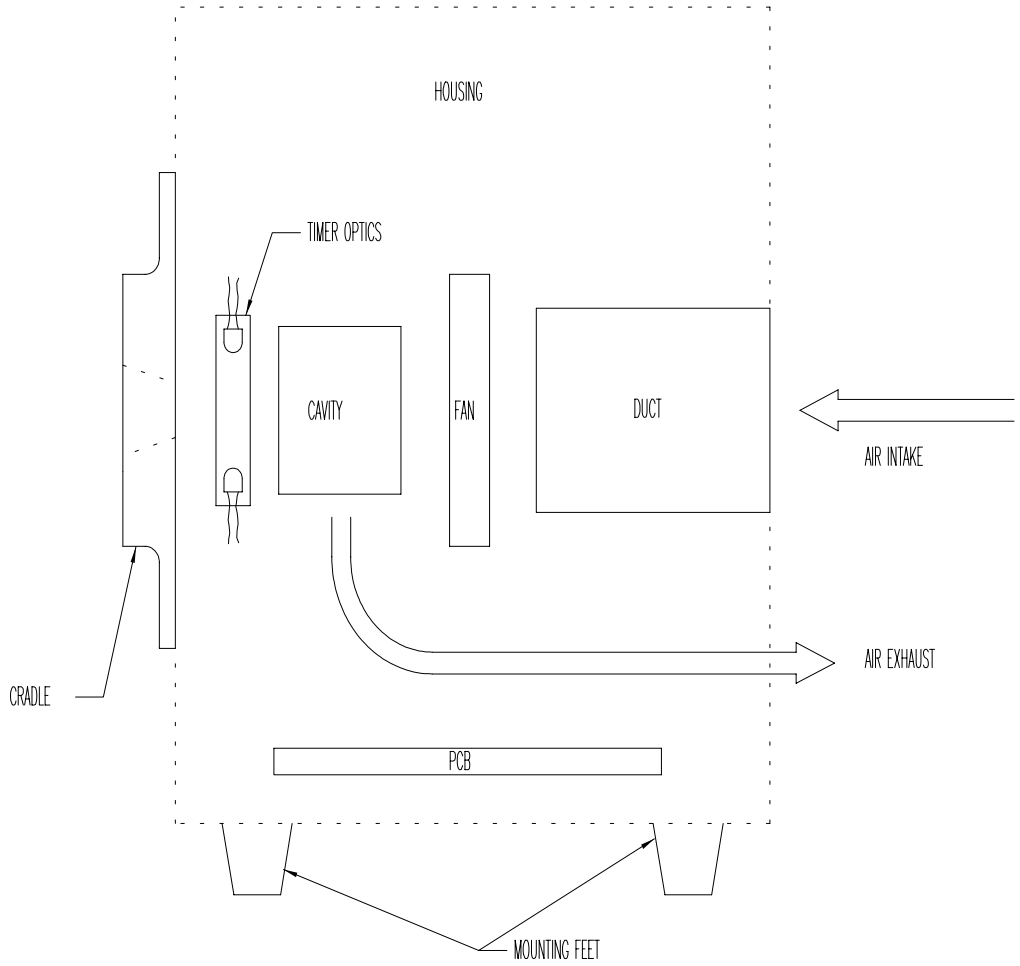
Operation of the BB 3200 is based on the emissivity (ε) factor which indicates how efficiently an object can emanate electromagnetic radiation from its surface. An ideal emitter has an emissivity equal to 1.00 or 100%. For instance, if an object has an emissivity of 0.90 (90%), it emits 90% of that thermal power which would be radiated by an ideal emitter at the same temperature.

The BB 3200 works under this principle. The BB 3200 cavity is manufactured and calibrated to have an emissivity rating of 0.990 $\pm$ 0.002. This is equivalent to the emissivity rating of the human ear at the tympanic membrane.

1.3 Construction

The BB 3200 is housed in a shock resistant case. The case is constructed of three metal sheets which are held together by eight screws. The blackbody assembly is a prefabricated device which contains the universal cradle, cavity housing, a cavity with built-in heater, a cooling fan, control and monitor thermistors with excellent thermal coupling, an air duct, a control circuit, timer optics, a stability indicator (GREEN/OFF light), and a power supply.

Figure 1.2 *Main Mechanical Components*

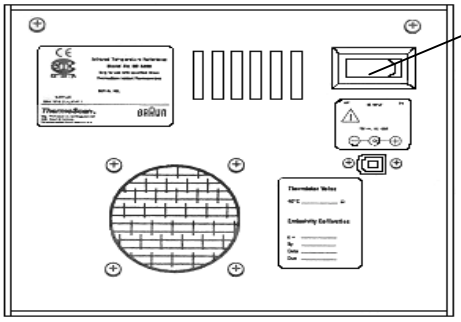


1.4 Specifications

Accuracy (over specified operating limits):	± 0.02°C (± 0.03°F)

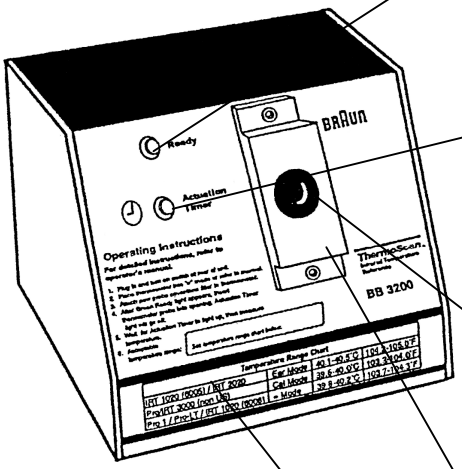
Temperature Setting:	40°C (104°F)
Ambient Temperature Range:	20°C - 25°C (68°F - 77°F)
Operating Humidity:	15% - 90%, non-condensing
Power Requirements:	230 V ~ ± 10%, 50 Hz ± 2% (International) 120 V ~ ±10%, 60 Hz ±2% (USA)
Power Consumption (max):	12 W DC 21 W AC
Dimension:	6.75 in. x 5.75 in .x 6.25 in. (17.15 cm. X 14.61 cm. X 15.88 cm.)
Warm-Up Time To Ready:	30 minutes maximum
Actuation Timer:	3 seconds nominal
Emissivity:	0.990 ± 0.002
Weight (including power adapter):	4 lbs (1.8 kg)

1.5 Controls (Inputs/Outputs)



ON/OFF Switch

Switch the low voltage power coming from the power adapter to the unit.



Ready Light

Illuminates green (ON) whenever the unit is ready to be used. It may be necessary to wait several minutes for unit to be fully stabilized after this indicator turns on for the first time.

Activation Timer Light

Illuminates three seconds after the thermometer's probe is first inserted into the blackbody cavity to indicate that the thermometer activation button should be depressed

Cavity Opening

Allows for the insertion of the thermometer's probe during testing. **Caution:** In order to obtain an accurate reading, it is necessary to ensure that thermometer probe is seated firmly in the cavity opening.

Thermometer Positioning Cradle

Allows acceptance of all current models of Braun ThermoScan thermometers.

Temperature Range Chart

This range chart allows users to verify the accuracy of various models of Braun ThermoScan thermometers.

Table 1-2 *Common Abbreviations*

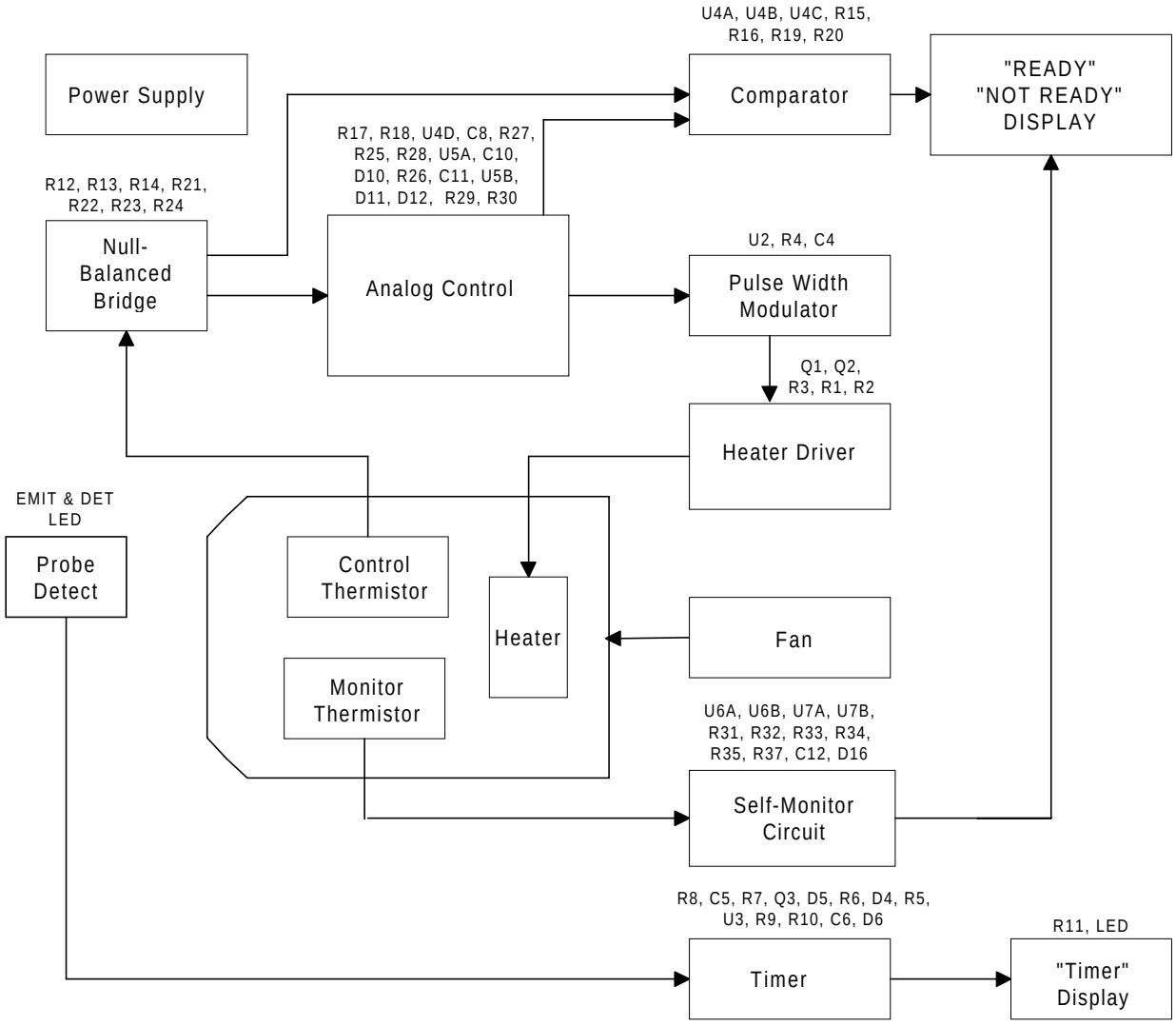
AC	alternating current	min.	minute
°C	degrees Celsius	no.,nos.	number or numbers
cm	centimeter	N/A	not applicable
cm^2	square centimeter	Ω	ohm
DC	direct current	PCB	printed circuit board
ε	emissivity	P/N	part number
°F	degrees Fahrenheit	PID	proportional-integration-differential
I	current	PWD	pulse width modulator
in.	inch	sec.	second
°K	degree Kelvin	S/N	serial number
kg	kilogram	T	temperature
kΩ	kilohm	V	volt
lbs	pounds	VDC	DC voltage
LED	light emitting diode	VAC	AC voltage
MΩ	megaohm	W	watt
μF	microfarad	λ	wavelength

Chapter 2
Functional Description

2.1 Introduction

The BB 3200 cavity is a good model of a constant infrared heat emitter where the opening, from where radiation is transmitted to the observer, is small with respect to the cavity size, and the wall temperature is uniform. This is provided by the cavity construction and a control loop, which maintains the constant wall temperature with very high accuracy.

Figure 2.1 *BB 3200 Electrical Block Diagram*



2.2 Power Supply

Power to the device is provided by an external wall mounted adapter (converting 115VAC or 230VAC to 12VDC). Unregulated voltage from the external adapter, after filtering, drives the cavity heater, fan, comparator, pulse-width-modulator, and the input for the 5 Volt regulator. Output from the 5 Volt regulator provides power for the timer.

2.3 Fan

The fan is mounted inside the cavity housing assembly. It is required for cooling to maintain a constant temperature in the cavity.

2.4 Heater

The heater is made up of a series of resistors (approximately equal to 6 Ω) and is installed inside the cavity housing assembly. The resistors are thermally coupled to the cavity housing.

2.5 Null-Balanced Bridge, Analog, Pulse Width Modulator, and Comparator Circuits

The Control thermistor is part of the Null-balanced bridge. An error signal from the bridge goes to Analog control, which has a PID (proportional-integration-differential) characteristic. The analog output signal of the Analog control is attached to the PWM controller, which generates rectangular pulses with a duty cycle proportional to the analog signal magnitude.

Pulses from the output of PWM go to the heater driver, which is a power transistor working in switch mode. The heater driver supplies the current for the heater. This controllable heater, along with the cooling fan is used to maintain constant temperature in the cavity. An amplified error signal is passed from the Analog control to the Comparator. The Comparator likewise receives the upper and lower limits of the voltage “window” from the Null-balanced bridge. If the output voltage of the Comparator is within the voltage “window” set by the upper-limit and lower-limit voltages, the “READY/NOT READY” Display turns green; otherwise it turns off.

2.6 Self-Monitor Circuit

The Self-Monitor circuit is a Comparator with a very narrow window. If for any reason the temperature maintained by the control loop changes outside specified limits, the signal from the output of the Self-Monitor circuit turns the “READY/NOT READY” LED off.

2.7 Timer Circuit

The Timer, along with the Probe-detect and "Timer" Display, is necessary to detect the presence of the thermometer to be tested and set the timer to three seconds. As soon as the thermometer is inserted, the "Timer" Display LED turns off for three seconds, and then turns back on. This timer LED display is used to ensure the temperature stability of the thermometer's probe tip inside the cavity.

2.8 Switches

There are two (2) electromechanical switches in the BB 3200.

1. ON/OFF switch connected to the PCB via wires is located on the back of the BB 3200. Its function is to switch ON/OFF the low voltage power coming from the power adapter to the unit.

2. RUN/CALIBRATION switch (S1) is accessible from the side of unit via a servicing port which is covered by a hole plug. It must be placed in the RUN position in order for the BB 3200 to function properly.

   Note: This switch is for factory calibration use only.

Figure 2-2 *BB 3200 Schematic Diagram*

(See hard copy for schematic diagram)

Chapter 3
Preventive Maintenance

3.1 Introduction

Servicing of the BB 3200 in the field is not authorized except for user service functions, i.e. cavity inspection. **Contact Braun ThermoScan or the Braun ThermoScan Authorized Service Center for other service.**

3.1.1 Maintenance and Calibration

In order to ensure that the BB 3200 is working properly, the following maintenance and calibration checks are recommended.

Procedure	Frequency	Corrective Action
Cavity Inspection	Every 3 months or whenever accuracy is questioned	Clean with inert gas; possible return for service
Thermistor Calibration	As specified on the Thermistor/Emissivity Calibration label or when Ready light stays OFF. Must be done by Authorized Service Center	Return for service
Emissivity Calibration	As specified on the Thermistor/Emissivity Calibration label. Must be done by Authorized Service Center.	Return for service

3.1.2 Cavity Inspection

The cavity should be inspected as noted in "Maintenance and Calibration" section or if the accuracy of the BB 3200 is in question.

1. Check cavity for lint, other foreign matter or scratches with otoscope or by looking into it with a probe cover with the tip cut off. Take care not to touch the cavity walls.

2. If the cavity is dirty, clean by blowing into it using inert gas or precision dust remover (e.g. dichlorodifluoromethane). Wait for thirty minutes before using to allow the interior of the cavity to stabilize. **Caution**: Cavity temperature may not be stable for up to thirty minutes after cleaning - **even if the READY light is green**.

3. If the cavity paint finish appears scratched or paint is flaking, return the unit to Braun ThermoScan or the Braun ThermoScan Authorized Service Center for service. **Caution**: If paint inside the cavity is found to be chipped or flaking, this could affect the emissivity calibration reading.

3.1.3 Thermistor and Emissivity Calibration

Thermistor and Emissivity calibration can only be performed by Braun ThemoScan Service Center. Refer to the Thermistor/Emissivity Calibration label on the rear of the BB 3200 for the date the Thermistor and Emissivity Calibration are due.

3.1.4 Cleaning

The BB 3200 housing case can be wiped clean with “normal” hospital cleaning solutions (i.e. mild soap and water, alcohol, etc.) **Caution:** Unit must be returned to authorized Braun Thermoscan Service Center for service if excessive fluid spills inside the BB 3200.

3.2 Service/Technical Inquiries (North America)

Should service be required during or after the warranty period, call Braun ThermoScan's Technical Service Center at (800) 327-7226 to obtain an authorization number. Repackage the BB 3200 carefully in its original box or any sturdy carton with enough packing material to prevent damage. Include a note describing the problem, authorization number, return address, and telephone number. For your protection, we also suggest that you ship your package in a traceable and insured manner, such as UPS, FedEx, or registered and insured Parcel Post. Send the instrument, postage prepaid, to:

Braun ThermoScan Inc.

ATTN: Authorization # _____ (Your Authorization Number)

10421 Pacific Center Court
San Diego, CA 92121-4339
U.S.A.

Answers to questions regarding operation of the BB 3200 may be obtained by calling us toll free at:

(800) 327- 7226

Monday-Friday

6:30 A.M. to 5:00 P.M. Pacific Time

Note: Contact your regional Braun ThermoScan authorized service center for outside North America.

Chapter 4
Troubleshooting

4.1 Introduction

Refer to the Braun ThermoScan Warranty before servicing the BB 3200 Infrared Temperature Reference. The only user service function currently available is cavity inspection and cleaning, as specified in the BB3200 Operator's Manual. Any other attempt to service the BB 3200 by anyone other than an authorized Braun ThermoScan service representative may invalidate the warranty. **Should service be required during or after the warranty period, contact your Braun ThermoScan Technical Service Center. See Section 3.2 "Service/Technical Inquiries (North America)".**

4.2 Possible Malfunctions

Functional problems with the BB 3200 may be separated into two groups depending on the complexity and specialized test equipment and tools required for their corrections:

- may be corrected by the end user
- must be corrected at an authorized Braun ThermoScan Service Center only

Table 4-1 Troubleshooting

CONDITION	PROBLEM	SOLUTION
Indicator lights and fan function normally, but thermometer reading is outside the limits.	If thermometer is in the wrong mode, readings will be high.	Verify that thermometer is in =, oral or ear mode, depending on thermometer type.
	Timing of reading may not be correct.	Make sure that you are holding thermometer in cavity for correct length of time - as indicated by the Actuation Timer light - prior to depressing activation button.
	If thermometer is removed from cavity too quickly, readings will be low.	Make sure to hold thermometer firmly in cavity until after activation button has been depressed for one second and released.
	Placement of thermometer in cavity may not be correct.	Make sure thermometer is seated firmly in the positioning cradle and cavity opening when taking reading.
	Thermometer may be in poor condition.	Verify that thermometer probe tip window is clean and intact. If window is dirty, clean per thermometer operator's manual. If window is broken or damaged, return thermometer to Authorized Service Center for service.
	There may be a probe cover (or lens filter) problem.	Verify that only one probe cover (or lens filter) is installed on thermometer. Verify that probe cover (or lens filter) is clean and intact. Repeat reading with new probe cover (or lens filter).
	Thermometer may be out of calibration.	Compare readings with that of another Braun Thermoscan Instant Thermometer, if possible. If only one thermometer is reading outside the limits, return it to factory for service. If all read high or all read low, see sections below.
	Missing probe cover or lens filter.	Install a new probe cover or lens filter.
	Dirt in the Infrared Temperature Reference cavity or damage to the cavity's emissive finish can cause low readings.	Inspect cavity as specified in the Cavity Inspection of this manual. If problem persists return unit to Authorized Service Center for service.
Indicator lights and fan function normally, but thermometer reading is outside the limits for repeat readings.	Insufficient time between readings.	Wait a minimum of one minute before taking repeat readings.
No lights are on ; fan is not operating.	Unit is not receiving power.	Verify that units is turned on. Verify that AC adapter is plugged securely into the Temperature Reference. Verify that AC adapter is plugged securely into outlet. Check wall outlet for power. Check AC adapter for damage; if damage, consult Authorized Service Center for service. If problem persists, return unit to Authorized Service Center for service.
Indicator lights are on, but fan is not operating properly.	Fan vent may be blocked.	Make sure that fan vent in back of unit is not blocked or excessively dirty.
	Fan or fan wiring may be broken.	Return to Authorized Service Center for service.

Table 4-1 Troubleshooting (Cont.)

CONDITION	PROBLEM	SOLUTION
Ready light does not turn steady green within 30 minutes	Temperature reference is unable to stabilize cavity temperature or resistance of thermistor is out of calibration limits.	Verify that conditions are within specified operating limits (room temperature, wall outlet voltage, etc.). Verify that fan vent in back of unit is not blocked. If Ready light consistently does not turn a steady green, return to Authorized Service Center for service.
Ready light does not turn on.	Light may be burned out.	Return to Authorized Service Center for service.
Actuation Timer light does not turn on.	Light may be burned out.	Return to Authorized Service Center for service.
Actuation Timer light does not turn off when thermometer is inserted into cavity.	Sensor may be blocked or damaged	Verify that flaps covering cavity opening are intact and not stuck in the open position. If problem persists, return unit to Authorized Service Center for service.